

REMARKS

Applicants request favorable reconsideration and allowance of the subject application in view of the preceding amendments and the following remarks.

To place the subject application in better form, the specification has been amended to correct minor informalities, including those noted by the Examiner. No new matter has been added by these changes.

Claims 1-22 are presented for consideration. Claims 1, 7, 13, 19 and 22 are independent.

Claims 5, 11 and 17 were objected to due to informalities. Specifically, the Examiner asserted that the written description does not adequately describe a projection magnification correction mechanism. This contention is respectfully traversed. Applicants submit that the mask stage tilt mechanism, for example, is capable of correcting the projection magnification. Accordingly, Applicants request reconsideration and withdrawal of this objection.

Applicants also request favorable reconsideration and withdrawal of the rejection set forth in the above-noted Office Action.

Claims 1-22 were rejected under 35 U.S.C. § 103 as being unpatentable over U.S. Patent No. H0,001,774 to Miyachi in view of U.S. Patent No. 6,727,980 to Ota et al. Applicants submit that the cited art, whether taken individually or in combination, does not teach many features of the present invention, as recited in independent claims 1, 7, 13, 19 and 22. Therefore, this rejection is respectfully traversed.

In one aspect of the present invention, independent claim 1 recites a scanning exposure apparatus including an illumination optical system for illuminating a pattern on a mask using

arc-shaped illumination light, a projection optical system for projecting the pattern on the mask illuminated by the illumination optical system onto a plate, a mask stage for scanning the mask, a plate stage for scanning the plate, the scanning exposure apparatus scanning the mask stage and plate stage synchronously relative to the projection optical system, a mask support mechanism for supporting a peripheral of the mask, and a mask stage tilt mechanism for arranging the pattern in an area illuminated by the arc-shaped illumination light in an object-surface-side focal plane of the projection optical system. The mask deforms due to its own weight from the peripheral support.

In another aspect of the present invention, independent claim 7 recites a scanning exposure apparatus including an illumination optical system for illuminating a pattern on a mask using arc-shaped illumination light, a projection optical system for projecting the pattern on the mask illuminated by the illumination optical system onto a plate, a mask stage for scanning the mask, a plate stage for scanning the plate, the scanning exposure apparatus scanning the mask stage and plate stage synchronously relative to the projection optical system, a mask support mechanism for supporting a peripheral of the mask, and a plate stage tilt mechanism for arranging a surface of the plate in an object-surface-side focal plane of the projection optical system, which plane images the pattern in an area illuminated by the arc-shaped illumination light. The mask deforms due to its own weight from the peripheral support.

In a further aspect of the present invention, independent claim 13 recites a scanning exposure apparatus including an illumination optical system for illuminating a pattern on a mask using arc-shaped illumination light, a projection optical system for projecting the pattern on the

mask illuminated by the illumination optical system onto a plate, a mask stage for scanning the mask, a plate stage for scanning the plate, the scanning exposure apparatus scanning the mask stage and plate stage synchronously relative to the projection optical system, a mask support mechanism for supporting a peripheral of the mask, and a mechanism for tilting the mask stage and the plate stage for arranging a surface of the plate in an object-surface-side focal plane of the projection optical system which plane images the pattern in an area illuminated by the arc-shaped illumination light. The mask deforms due to its own weight from the peripheral support.

In still another aspect of the present invention, independent claim 19 recites a scanning exposure method for illuminating a pattern on a mask using arc-shaped illumination light, and for projecting the pattern on the mask illuminated by the illumination optical system onto a plate. The scanning exposure apparatus scans the mask and plate synchronously relative to a projection optical system. The method includes the steps of exposing a focus-measurement pattern mask, measuring a focus position of a specific area from light intensity or resolution performance of a focus measurement pattern image on the plate, interpolating a measurement result linearly and identifying an image plane position, calculating a tilt angle for tilting the mask and/or plate to arrange a surface of the plate on a focal plane at an image-surface position, correcting a tilt of a mask stage and/or plate stage based on calculated data, and exposing an actual mask.

In yet a further aspect of the present invention, independent claim 22 recites a device fabrication method including the steps of exposing a device pattern onto a plate using a scanning exposure method, and developing the plate that has been exposed. The scanning exposure method illuminates a pattern on a mask using arc-shaped illumination light, and projects the

pattern on the mask illuminated by the illumination optical system onto a plate. The scanning exposure apparatus scans the mask and plate synchronously relative to a projection optical system. The method includes the steps of exposing a focus-measurement pattern mask, measuring a focus position of a specific area from light intensity or resolution performance of a focus measurement pattern image on the plate, interpolating a measurement result linearly and identifying an image plane position, calculating a tilt angle for tilting the mask and/or plate to arrange a surface of the plate on a focal plane at an image-surface position, correcting a tilt of a mask stage and/or plate stage based on calculated data, and exposing an actual mask.

Applicants submit that the cited art, whether taken individually or in combination, does not teach or suggest such features of the present invention, as recited in independent claims 1, 7, 13, 19 and 22.

The Miyaki document discloses a scanning exposure apparatus that illuminates a pattern of a reticle (or mask) per slit and exposes a substrate while synchronously moving the reticle and the substrate. The device in that document attempts to accord an image surface that corresponds to a slit illuminated area with a surface of the substrate by adjusting a tilt of the substrate according to a scanning amount of a reticle stage or its tilt in a scanning direction.

The Ota et al. patent discloses a scanning exposure apparatus that illuminates a reflection mask through an arc-shaped illumination arrangement. The reflection mask does not ordinarily deform by its own weight, however, because the entire back surface of the mask is absorbed and held.

On the other hand, the present invention is directed to various aspects of scanning exposure apparatus and related method that illuminates a pattern of a mask through arc-shaped illumination and exposes the substrate while synchronously moving the mask and the substrate. This arrangement is able to accord an image surface that corresponds to a slit illuminated area with a surface of the substrate by adjusting a tilt of the substrate according to a scanning amount of a reticle stage or its tilt in the scanning direction when the mask is supported around its periphery and its center deforms by its own weight.

The Examiner takes the position that the present invention would have been obvious in view of the Miyaki document when considered with the Ota et al. patent. Applicants note that in the exposure apparatus of the Miyaki document, the periphery of the reticle is supported, but the center part of the reticle is not supported. Therefore, it may be expected that the reticle will deform by its own weight. Applicants submit, however, that the Miyaki document does not teach or suggest that the light illuminating the reticle should be arc-shaped.

The Ota et al. patent, on the other hand, discloses a scanning exposure apparatus that provides arc-shaped illumination, but the Ota et al. patent is silent with respect to a reticle deforming by its own weight.

Generally speaking, the use of rectangular illumination would not eliminate a defocus in an area illuminated by rectangular illumination, even if a mask or a substrate is tilted in a scanning direction. On the other hand, the inventors of the subject application have discovered that the use of arc-shaped illumination eliminates a defocus over the entire area illuminated by the arc-shaped illumination, by tilting the mask or the substrate in the scanning direction so as to

accord the arc of the illuminating light with the arc of a section that intersects a horizontal surface of an inclined mask. Thus, the present invention can achieve those results as discussed on page 23, line 24, to page 24, line 25, of the subject specification.

For the reasons noted above, Applicants submit that even if the device in the Miyaki document were combined with the arrangement in the Ota et al. patent using arc-shaped illumination, those citations would not teach or suggest the advantages provided by the present invention. Applicants submit, therefore, that the cited art, whether taken individually or in combination, does not teach or suggest salient features of Applicants' present invention, as recited in independent claims 1, 7, 13, 19 and 22.

For the foregoing reasons, Applicants submit that the present invention, as recited in independent claims 1, 7, 13, 19 and 22, is patentably defined over the cited art.

Dependent claims 2-6, 8-12, 14-18, 20 and 21 also should be deemed allowable, in their own right, for defining other patentable features of the present invention in addition to those recited in their respective independent claims. Further individual consideration of these dependent claims is requested.

Applicants further submit that the instant application is in condition for allowance. Favorable reconsideration, withdrawal of the rejection set forth in the above-noted Office Action and an early Notice of Allowance are requested.

Applicants' undersigned attorney may be reached in our Washington, D.C. office by telephone at (202) 530-1010 All correspondence should continue to be directed to our address given below.

Respectfully submitted,

A handwritten signature in black ink, appearing to read "Steven E. Warner", is written over a horizontal line.

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